Delaware City Refinery – Shoreline Stabilization Project

Applicant: Delaware City Refining Company, LLC

Agent: Cardno ENTRIX, New Castle, DE

Presentation Agenda

- Project Setting and Need
- The Chosen Technology
- Proposed Project
  - > Benefits of Technology
  - > Project Concerns
  - > Data Collection & Modelling
  - > Design Elements

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Project Setting & Need

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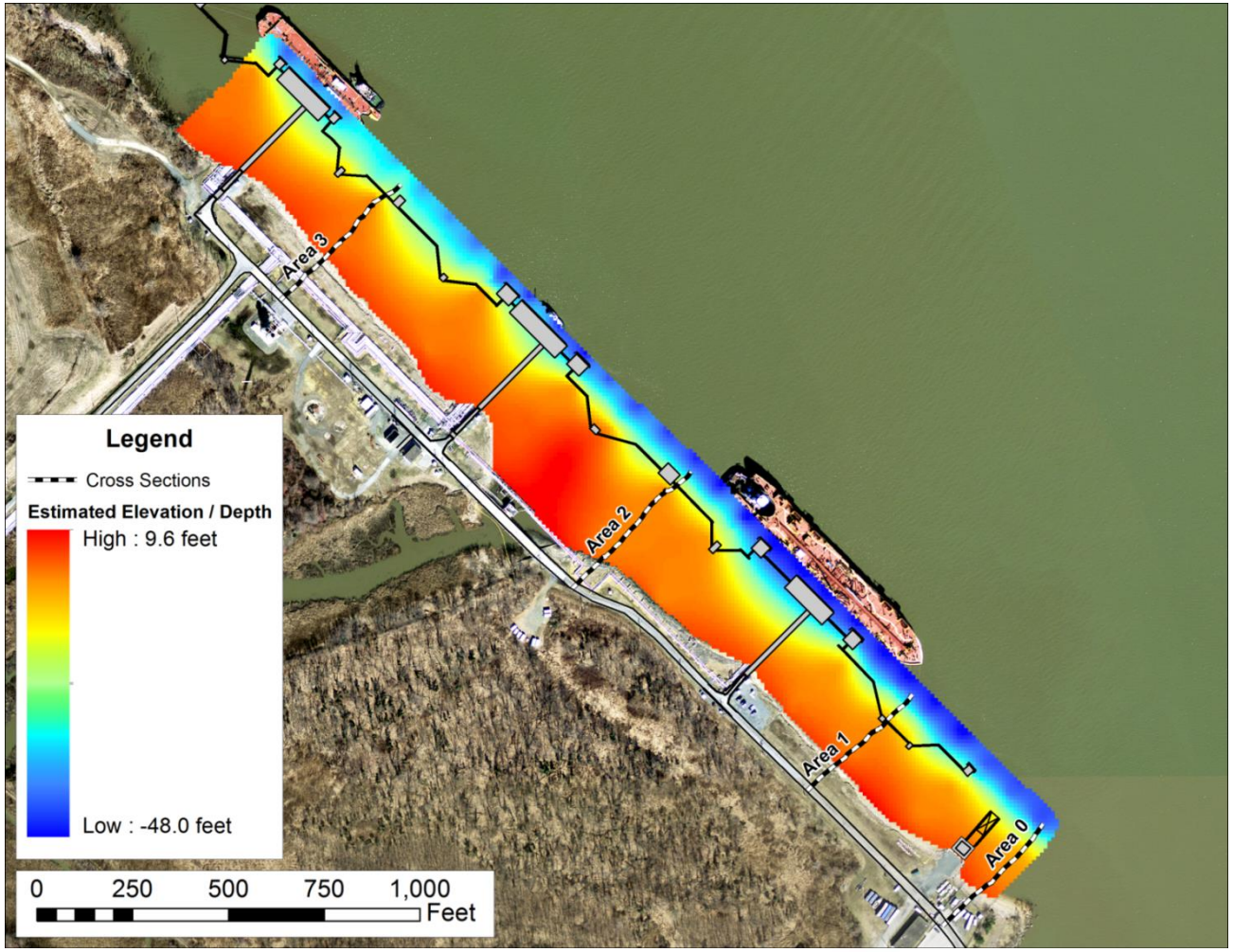
Project Site Bathymetry



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2007 Comparison

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Current Profile – Area 0

Photo Location

Photo Location — Approximate 2/2012 Erosion Limit — Current Erosion Limit

Photo 1839

Photo 1840

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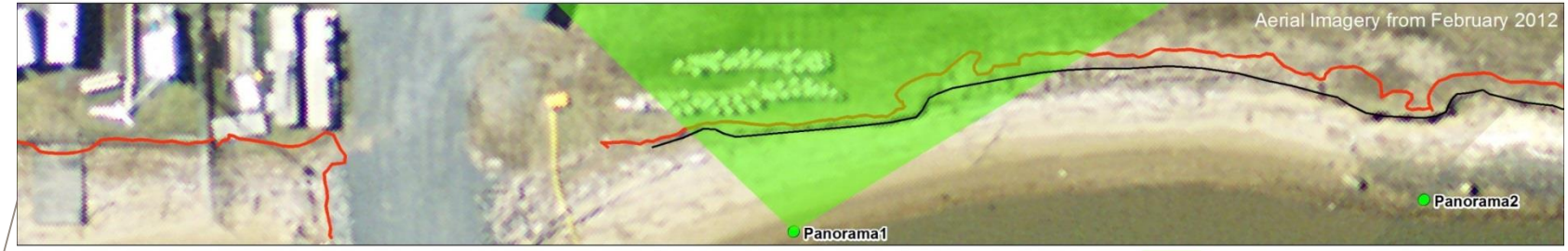
Current Profile Area 1

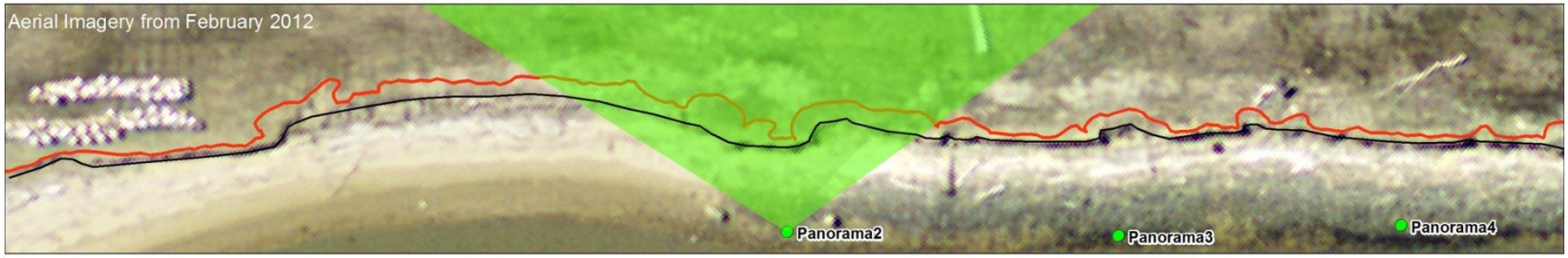
Panoramic Photo Coverage



Panorama 1

Current Profile Area 1

Panoramic Photo Coverage



Panorama 2

Current Profile Area 1

Panoramic Photo Coverage

Photo Location — Approximate 2/2012 Erosion Limit — Current Erosion Limit — Panoramic Photo Coverage

Panorama 3

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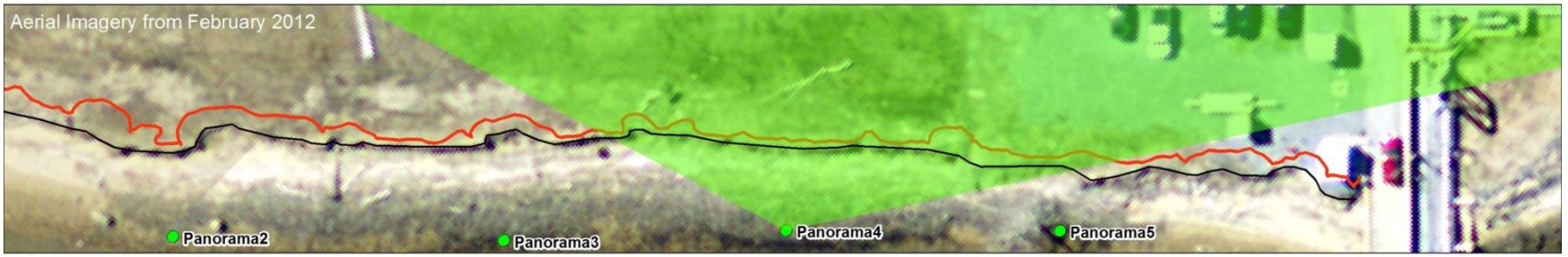
Current Profile Area 1

Panoramic Photo Coverage



Panorama 4

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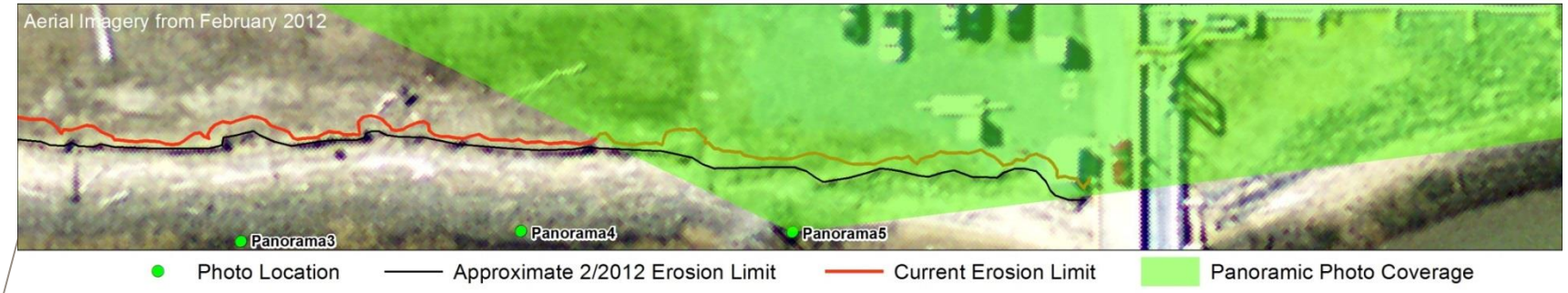
Current Profile Area 1

Panoramic Photo Coverage



Panorama 5

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Current Profile Area 1

Panoramic Photo Coverage

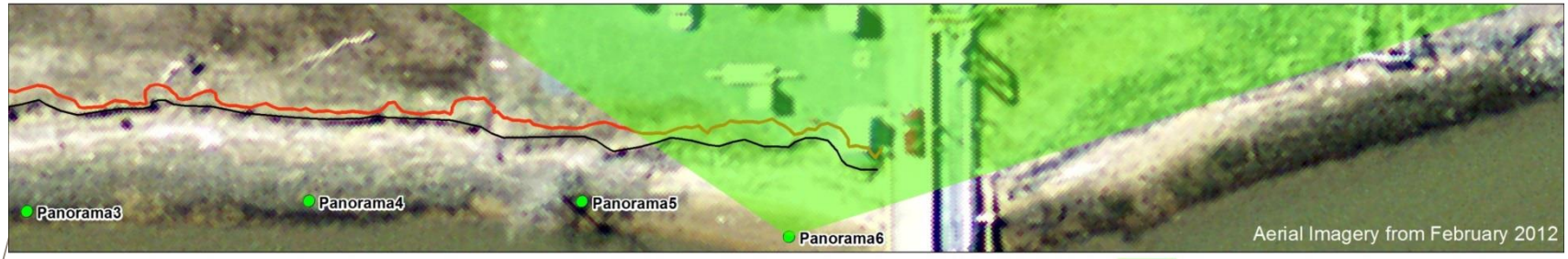

Photo Location — Approximate 2/2012 Erosion Limit — Current Erosion Limit — Panoramic Photo Coverage

Panorama 6

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Key Area Examples

Fire Safety Infrastructure could be at risk.

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Chosen Technology: Wave Energy Attenuation

The Science Behind the Technology

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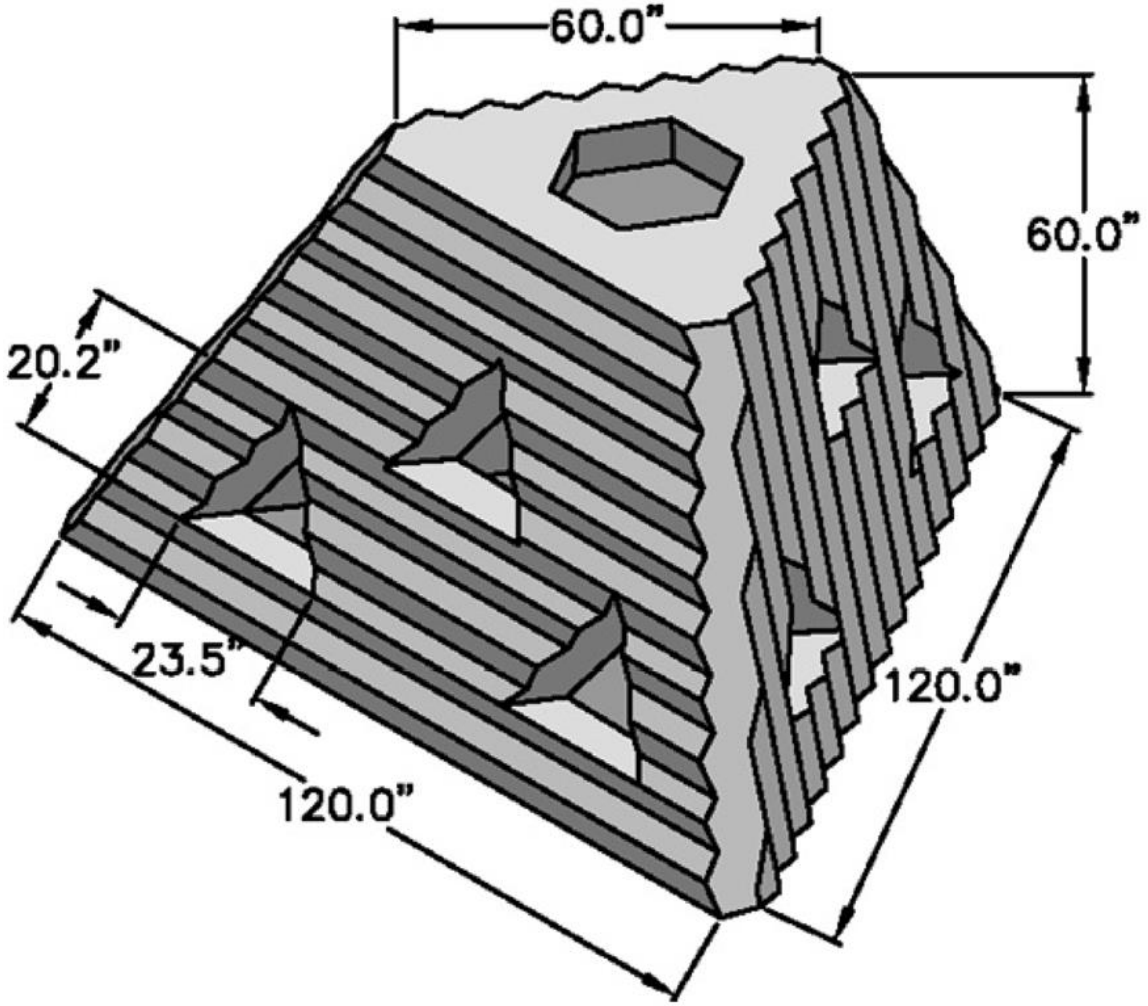
What is a WAD?
Wave Attenuation Device (WAD)



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How Are They Made?

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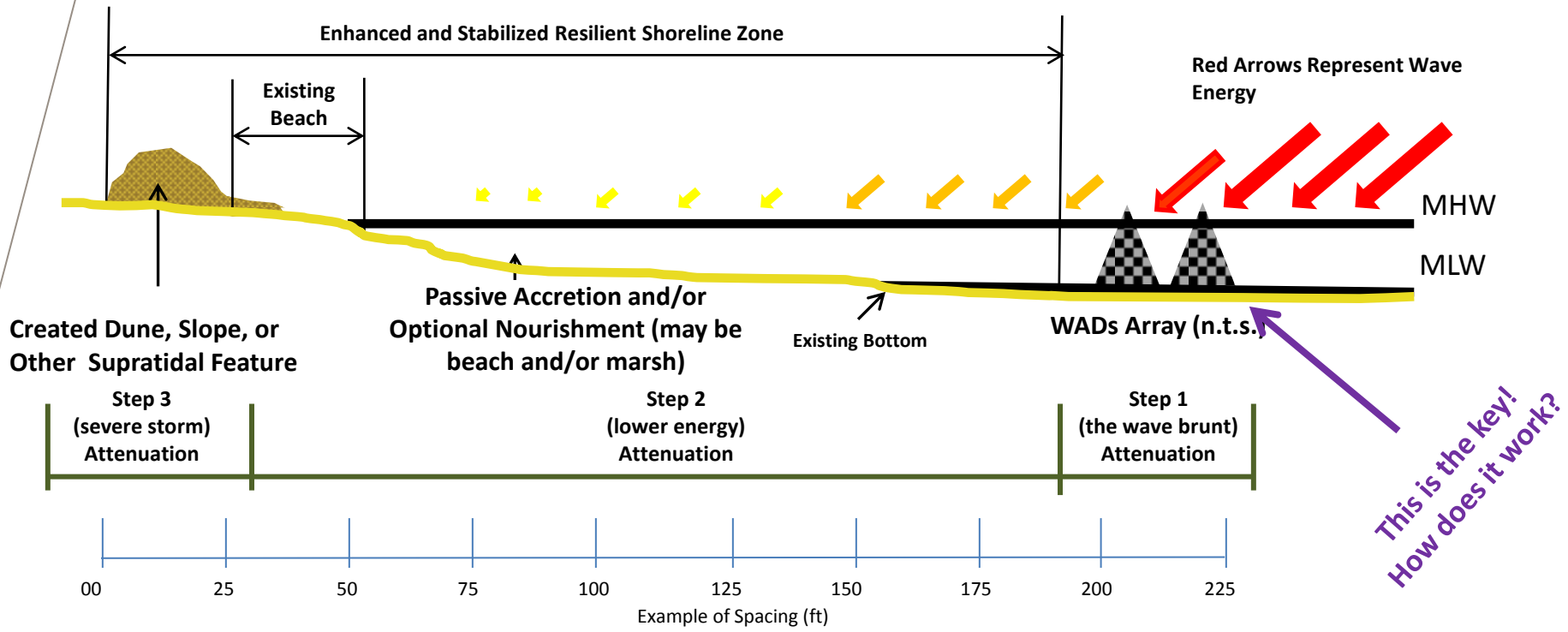
How Do WADs Work



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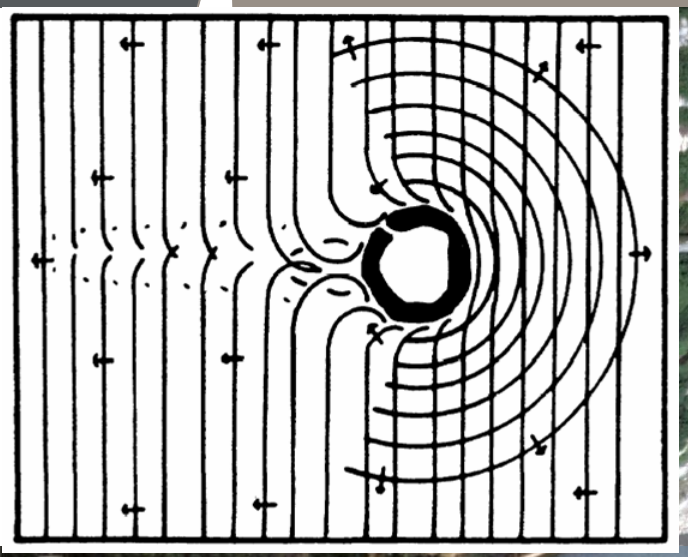
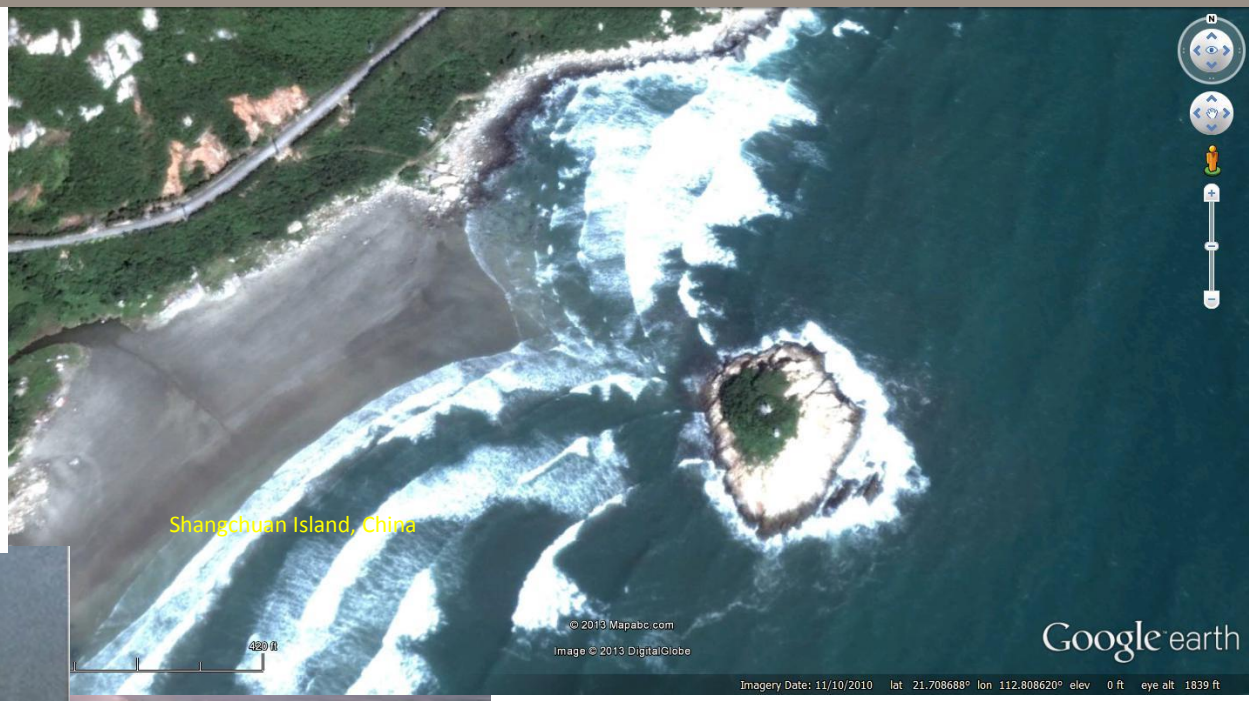
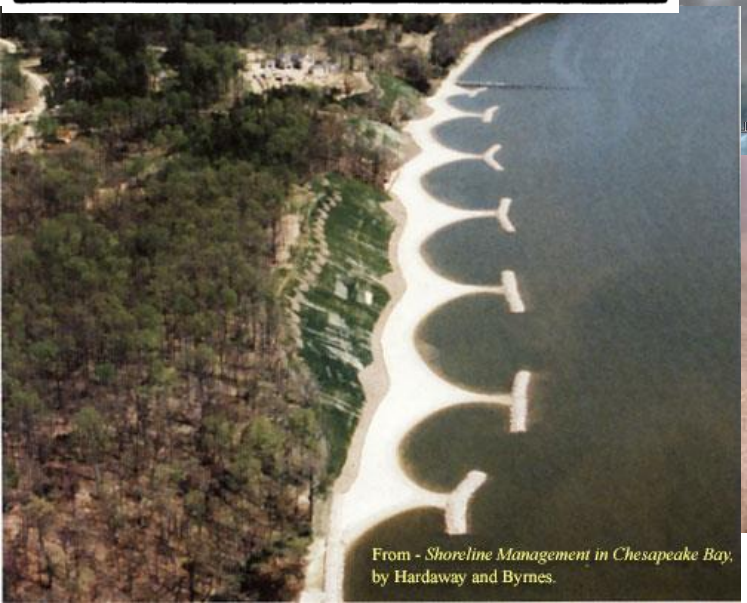
Wave Attenuation is Different From a Breakwater







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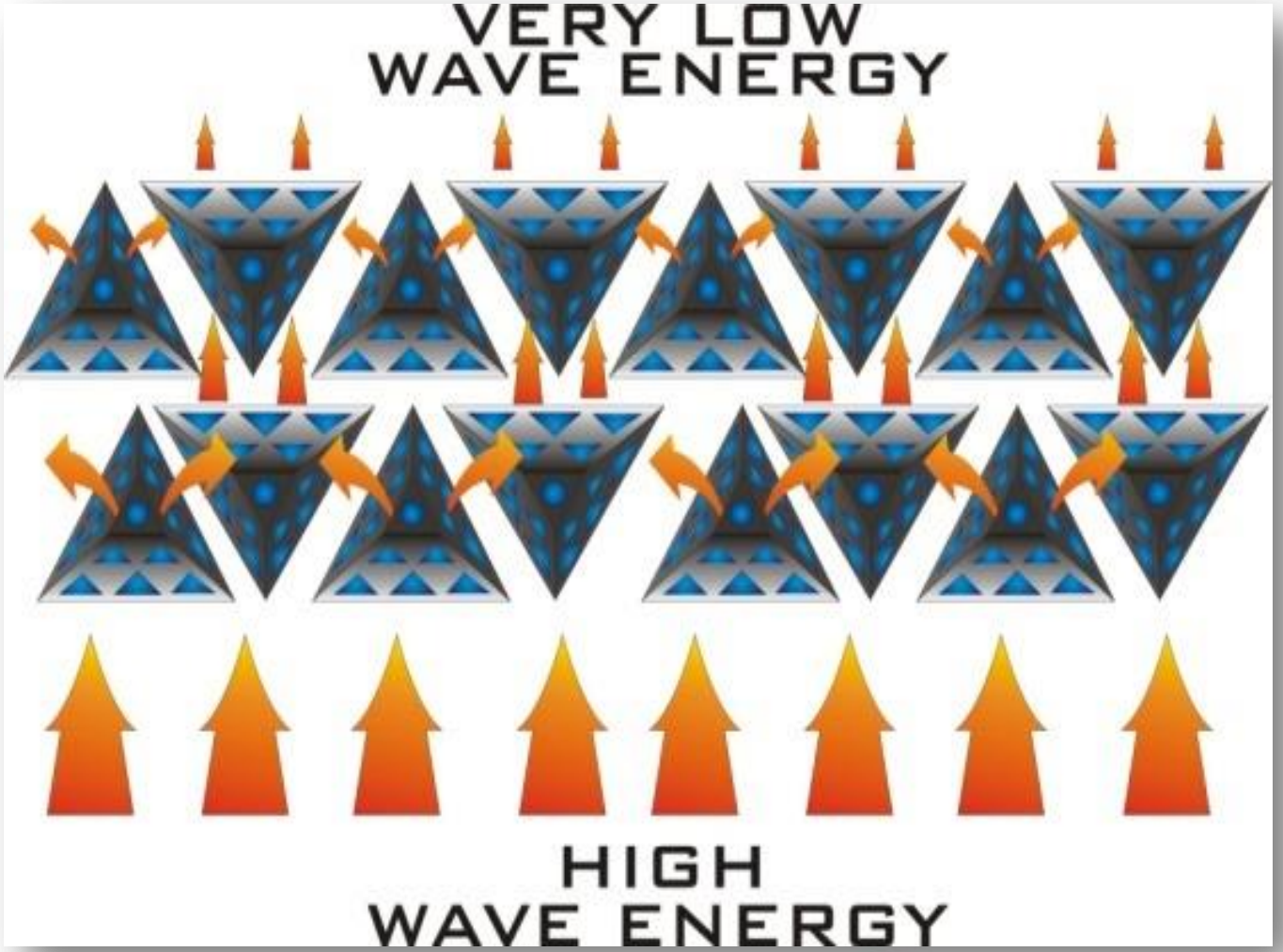
How Wave Attenuation Works



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WADs in Action

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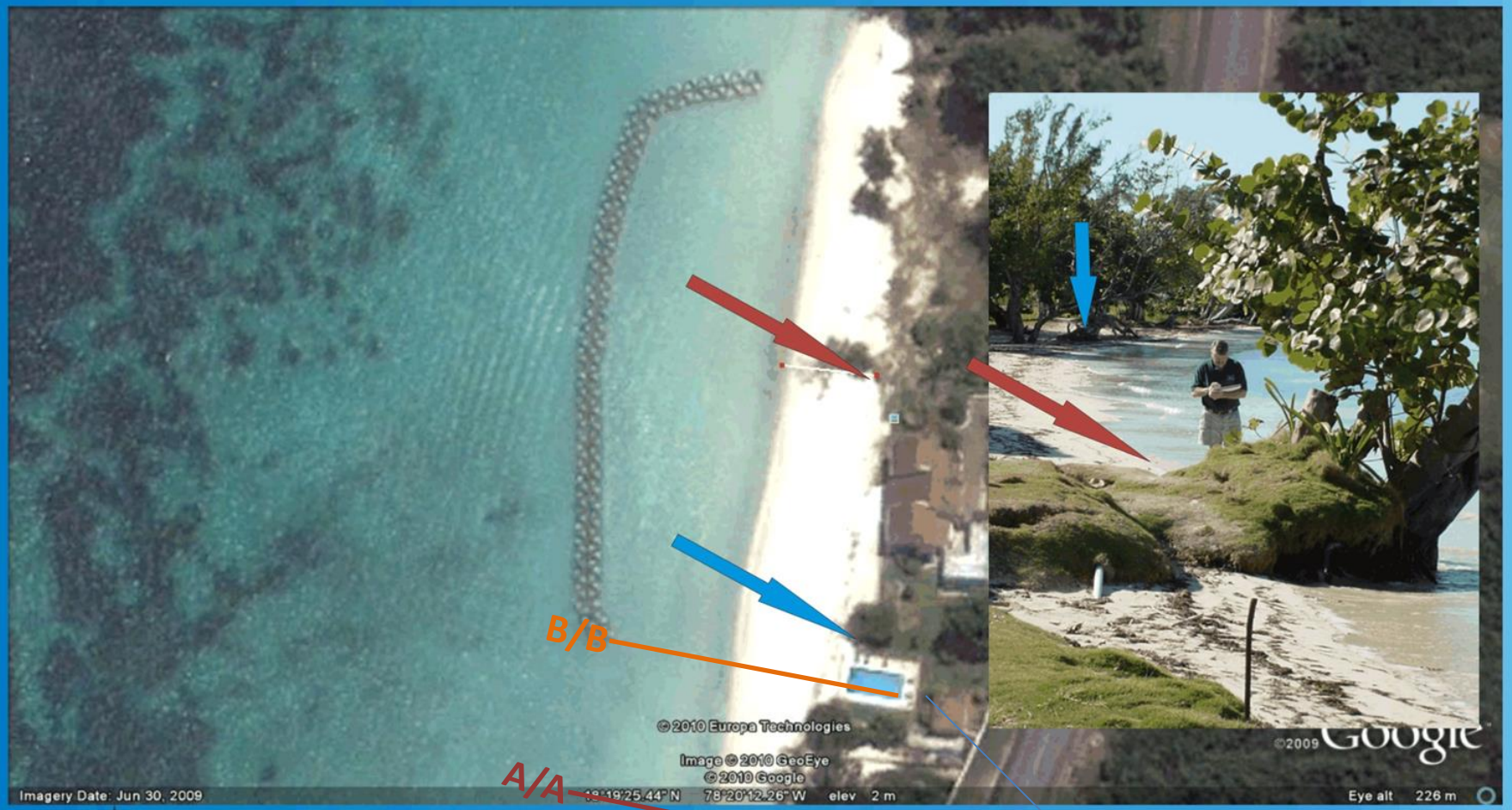


+ GAIN 55 FEET

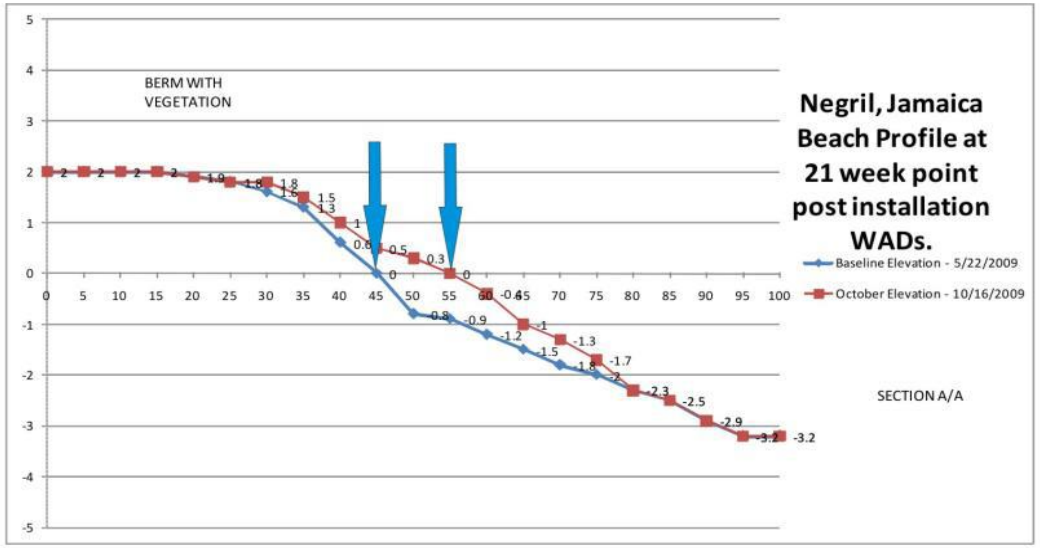
DEPLOYMENT COMPLETE DATE 22 MAY 2009

SAT IMAGERY TAKEN ON JUNE 30 2009 39 DAYS LATER

SURVEYOR STANDING IN WATER AT BENCHMARK
NOTE BLUE ARROW FOR PERSPECTIVE

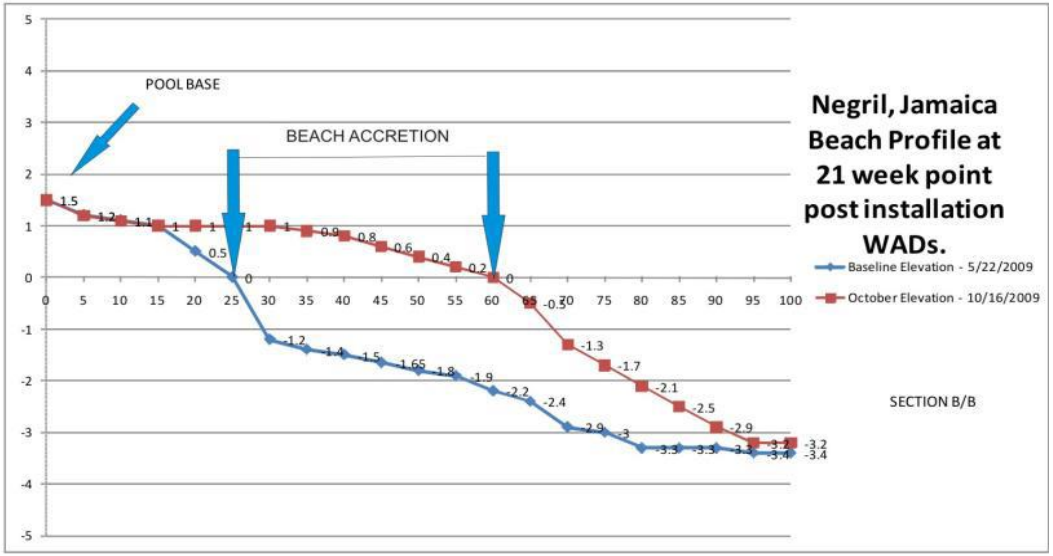
Living Shorelines Solutions, Inc.

DADE CITY, FLORIDA



SECTION SOUTH
A/A
GAIN 10 FEET

SECTION B/B
GAIN 35 FEET



Living Shorelines Solutions, Inc.

DADE CITY, FLORIDA

Passive Accretion and/or Sediment Conservation?

Cape Charles, VA

- **WAD Deployment occurred just before SS Sandy hit.**
- **Year 1 monitoring results.**

- **Above: Note similar tide elevations by the amount the WADs are exposed**
- **Right/Above: Note the passive accretion in one year**

Thank you LSS, Inc., *Dade City, FL* ***& Mid Atlantic Environmental LLC,*** *Virginia Beach, VA for sharing monitoring photography*

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Benefits of Technology

- Provides Shoreline stabilization (wave energy attenuation)
- Nearly eliminates loss of soils and sediment due to shoreline erosion (sediment conservation)
- Helps maintain emergency response capabilities (infrastructure protection)
- Provides resilience (50+ years)
- Intertidal substrate enhancement and stabilization (provides for passive accretion)

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The Proposed Delaware City Refining Company Shoreline Stabilization Project

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Project Concerns

This Project:

- Is not applying for or receiving any State funding
- Is not being performed for, or in relation to, any change in operation;
- Will not increase the potential for oil spills
- Will not impact any historic or cultural properties or lands
- Will not increase fish mortality associated with the facilities water intake structure;
- Does not have anything to due with the facilities processing or handling of crude products; and
- Will not increase the risk to the heronry at Pea Patch Island relative to a chance of an oil spill.

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Agency and Public Coordination

- **State Historic Preservation Office (SHPO):** Has determined no historic properties, eligible for or listed in the National Register of Historic Places, will be affected.
- **National Marine Fisheries Service (Endangered Species Act Review):** Any affect to T&E species will be insignificant or discountable; no further consultation required.
- **National Marine Fisheries Service (Essential Fish Habitat Review):** Three Comments:
  - > Typical seasonal restrictions
  - > Monitor accretion and erosion reduction
  - > Use clean material for nourishment.
- **National Marine Fisheries Service (Fish and Wildlife Coordination Act Review):** Recommend vegetative stabilization behind coir fiber logs.
- **Four Public Notices:**
  - > Delaware DNREC - Wetland and Subaqueous Lands Section
  - > U.S. Army Corps of Engineers
  - > Delaware DNREC – Coastal Zone Programs (two public Notices)

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Data Collection & Modeling

- Bathymetry & Supporting Land Survey (Tie-ins)
- Geotechnical
  - > Grain Size
  - > Compression Tests
- Modeling CMS-Wave Modeling Develop by USACE
- Climatic & Tidal data obtained from NOAA

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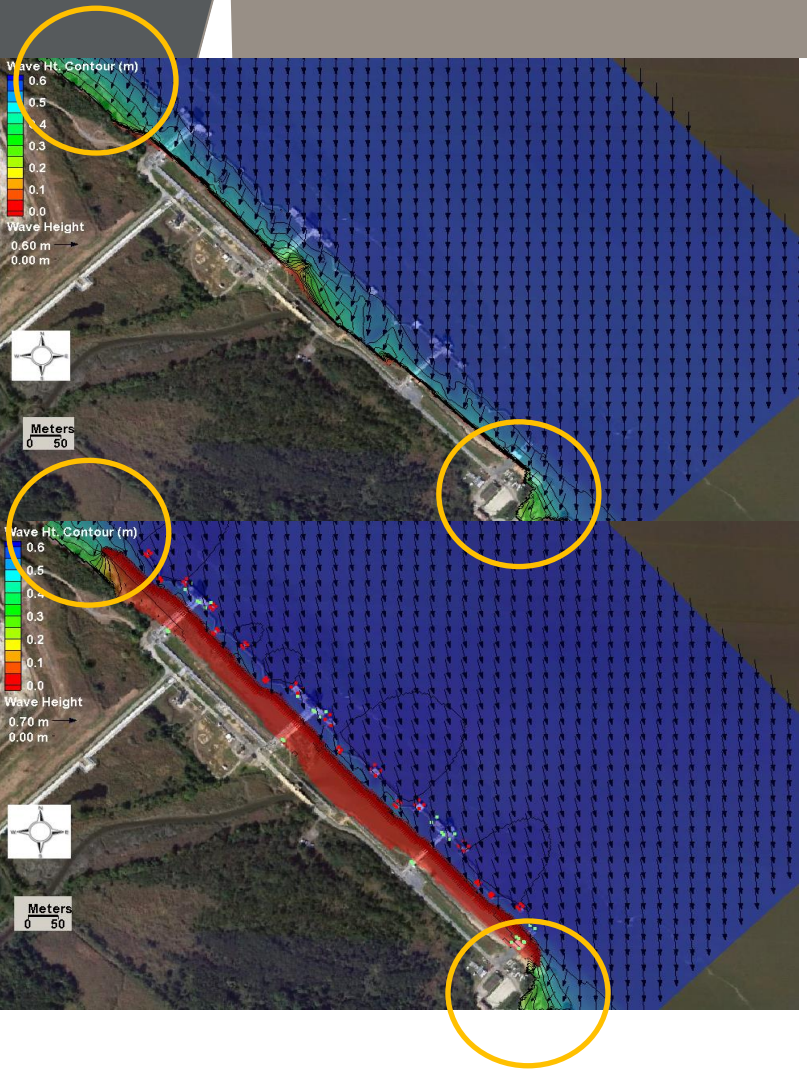
What does the Modelling Say?



Top picture: Shows significant wave energy is contacting shoreline

Bottom picture: Shows the use of WADs nearly eliminates wave energy from contacting shoreline (red is almost no wave)

Note: The modeling also indicates that the WADs will not affect areas off-site.

Preliminary modeling results predict near 100% wave attenuation under this and lesser energy scenarios.

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Design Elements

- Wave Energy Attenuation Devices (WADs™)
- Minor Nourishment and Upland Fill:
  - > To Restore Pre-existing Slopes
- Improved Boom System:
  - > Protective of the Shoreline and WADs

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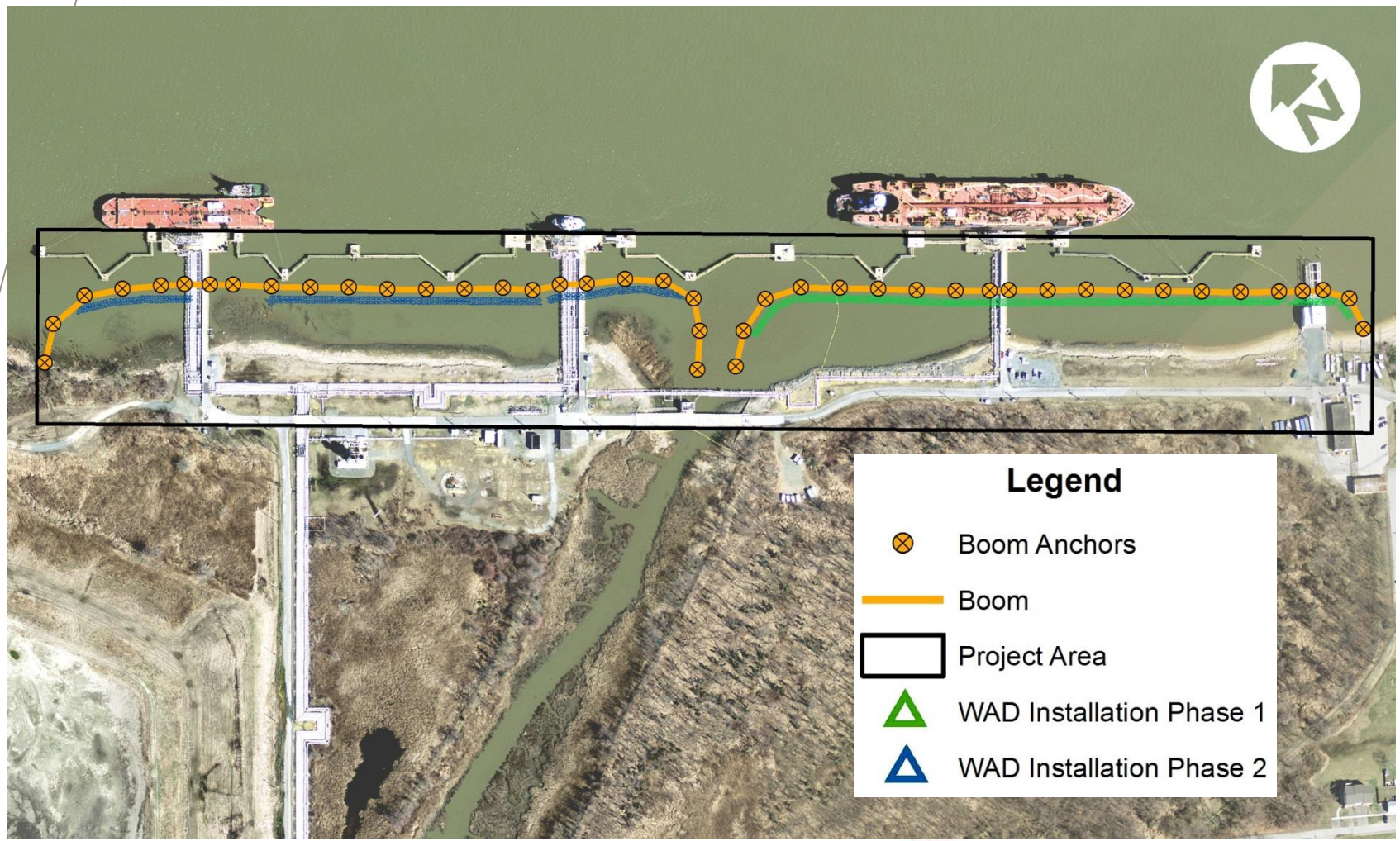
Site Layout



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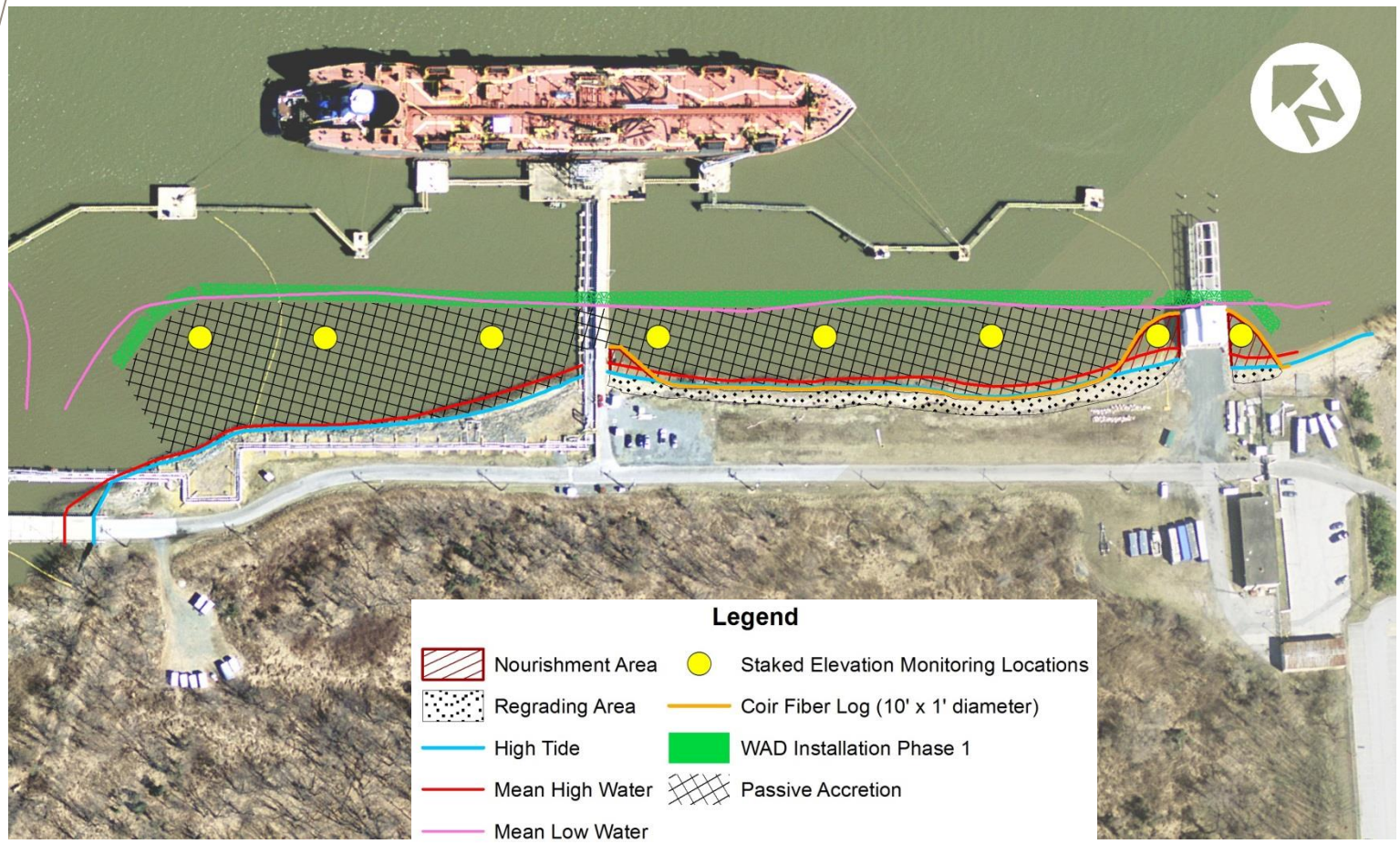
Minor Nourishment and Upland Fill



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Thank You

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